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ABSTRACT

This paper presents the results of research that compared the academic achievement of high school students enrolled in an integrated Advanced Placement Biology/Advanced Placement Calculus course with students enrolled in traditional Advanced Placement Biology and Advanced Placement Calculus courses. Study subjects included high school students (n=1780) from a Midwestern suburban high school. (YDS)

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Raise Test Scores: Integrate Biology and Calculus

by
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The purpose of this research was to compare the academic achievement of high school students enrolled in an integrated Advanced Placement Biology/Advanced Placement Calculus course with similar students enrolled in traditional Advanced Placement Biology and Advanced Placement Calculus courses.

There is no lack of articles about the advantages of an integrated curriculum. Conferences are held, professional development workshops are both offered and required, and opportunities for training are more abundant than ever. In spite of all of this, the real desire for integration of mathematics and science seems to remain superficial; mathematics and science continue to be taught separately in most middle and high schools. "Throughout the literature, there is a general sense that integration is a 'good thing.' However, very little has been reported that explicitly describes what it means to integrate mathematics and science, and even less research has been done to explore its benefits and detriments" (Berlin and White, 1995). Hopefully, the results of this study provide the motivation for some science teachers to overcome the reluctance to integrate mathematics into their curricula.

Theoretical Perspective

1. The National Council of Teachers of Mathematics (NCTM) stated that, "School science and mathematics programs should be coordinated so that students learn the necessary mathematical skills and concepts before and during their use in the science program." (NCTM, 1998)

2. The National Association of Secondary School Principals (NASSP, 1996) recommended that the high school integrate its curriculum to the extent possible and emphasize depth over breadth

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of coverage. The NASSP goes on to say that teaching subjects in isolation from each other, as high schools are wont to do, distorts knowledge.

3. The American Association for the Advancement of Science (1993) stated that by recommending increased emphasis on connections between science and other disciplines, educators can encourage students not only to know scientific facts, but also to view the world scientifically.

The Population

The population used in this study included students at a Midwestern suburban high school with an enrollment of 1780 students in grades 9 - 12. A course entitled "AP Biology/AP Calculus" was designed to be a 2- period course that had the goal of integrating science and mathematics. Students who register for the AP Biology/AP Calculus block course are together for two consecutive periods. The traditional AP Biology course was taught by the same teacher who taught the AP Biology block class.

Grade point averages at the researcher's high school are calculated on a 4.0 scale and all classes receive the same grade point value for the same letter grade. In other words, there is no weighting of grades for Advanced Placement courses. A statistical comparison of the grade point averages of students enrolled in the AP Biology/AP Calculus block class and the students enrolled in the separate AP Biology and AP Calculus classes were compared. The mean GPA for students enrolled in the block class was 3.78 (n=39), while the mean GPA for students enrolled in the separate classes was 3.68 (n=27). The t-test for independent samples indicated a lack of significant difference between the block class and separate classes. The t-value (t=1.53) was insignificant at the $p<.05$ level.

Instrumentation

The Advanced Placement exams are scored on a scale of 1 - 5, with 5 being the highest possible score on each exam. The majority of colleges and universities in the United States consider a score of 3 to be passing, and the student will earn college credit for a score of 3 or higher.

Findings

1. A statistical comparison of the AP Biology Exam scores of students enrolled in the AP Biology/AP Calculus block class and the students enrolled in the separate AP Biology and AP Calculus classes was made. The cumulative mean AP Exam score for students enrolled in the block class during the 1997-99 school years was 3.56 (n=39), while the mean GPA for students enrolled in the separate classes was 2.85 (n=27). This represents a 24.9% higher achievement on the Advanced Placement Biology Exam for the students in the block class compared to those in the separate classes during the entire two-year study period. The t-test for independent samples indicated a significant difference between the block class and the separate classes. The t-value ($t=2.82$) was significant at the $p<.05$ level.

2. The percentage of students passing the AP Biology exam who were enrolled in the AP Biology/AP Calculus block class during the 1997-99 school years was 85% (n=39), while the percentage passing among the students in the separate classes was 56% (n=27). A "passing" score on the Advanced Placement Biology Exam is considered to be 3 or higher on a scale of 1-5. Students enrolled in the block class over the two-years of this study earned passing scores at a 29% higher rate than those students in the separate classes.

Conclusions

Students enrolled in the integrated Advanced Placement Biology/Advanced Placement Calculus block course performed significantly better on the Advanced Placement Biology exam when compared to students enrolled in the traditional Advanced Placement Biology and Advanced Placement Calculus courses. There appears to be a positive correlation between integrating science and mathematics in the high school setting and the understanding and achievement of the students enrolled in the integrated course.

As both the National Science Standards and the National Mathematics Standards advocate, it is imperative that these disciplines become effectively and smoothly integrated at all possible levels. Science provides the experimental design and experimental data, and mathematics provides a means by which these data can be analyzed and evaluated. In reality, each is fragmented without the other. It is irresponsible and shortsighted of educational leaders to continue to think of each subject area as separate and distinct from all others.

Every year the general public cries louder and stronger for higher student achievement as measured by the only criteria most people understand: higher standardized test scores. School districts in general, and teachers in particular, are berated for what is viewed as sub-standard performance by their students. The results of this study are an indication of the power of integrating biology and calculus. It has been said in baseball that, "You can't steal second and keep your foot on first." To paraphrase, unless you are willing to take a risk, progress will not be realized. It is time to take a risk and integrate science and mathematics.

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